Space Technology Research Grants

Fabrication Techniques of Stretchable and Cloth Electroadhesion Samples for Implementation on Devices with Space Application

Completed Technology Project (2017 - 2021)

Project Introduction

The purpose of this study is to determine materials and fabrication techniques for efficient space-rated electroadhesion (EA) samples. Liquid metals, including gallium-indium alloy \cite{tabatabai}, as electrodes embedded in an insulating polymer in various patterns will be studied in a vacuum environment, and optimized for application in spacecraft docking, astronaut space suits, and spacewalk gripper devices. Further, this study will characterize materials and fabrication techniques for EA cloths applied as spacecraft blankets with dual purpose of protecting exposed spacecraft surfaces in a space environment and adhesively attaching to objects through a control system. This study focuses on TABS element 4.6.3 in using EA technology as a docking and capture mechanism. As a lightweight, low cost, and low power alternative to traditional mechanical docking mechanisms, EA mechanisms in alignment with TA 4.6.3.1 will be integrated as docking and automated rendezvous systems. Advancing scientific knowledge of EA effects, this technology provides alternative capture devices for future Mars missions, specifically for the Human Exploration and Operations Mission Directorate, and current space walks on the ISS. Additionally, EA grippers and grabber claws may be used by astronauts on spacewalks to maneuver or collect rocks for scientific studies on Mars. With application in spacecraft docking, orbital debris mitigation, and space walk devices, the fabrication of stretchable EA samples and EA clothes has broader impact in the benefits to the advancement of space technology. Further, stretchable EA has application in the adhesive grabbing of multiple object sizes, and objects that change size over time, as the EA samples are capable of stretching in size. With paper submissions to share research at conferences and outreach to local schools with interactive presentations on EA technology, the public and scientific community will benefit from progression in EA research. As the scientific frontier of space travel advances to Mars and asteroids, adhesive devices using EA technology allow for acquisition of new scientific measurements, accelerating our understanding of the vast universe. Further, research in EA technology with spacecraft docking application benefits society globally with the advancement of space travel. Similar to many technologies that began as space applications and became integral in society, such as cordless tools and long distance communication (NASA), EA advancements are useful as consumer gripper devices and, with further research, may be applied in every-day life.

Anticipated Benefits

With application in spacecraft docking, orbital debris mitigation, and space walk devices, the fabrication of stretchable EA samples and EA clothes has broader impact in the benefits to the advancement of space technology. Further, stretchable EA has application in the adhesive grabbing of multiple object sizes, and objects that change size over time, as the EA samples are capable of stretching in size. As the scientific frontier of space travel advances to Mars and asteroids, adhesive devices using EA technology allow for

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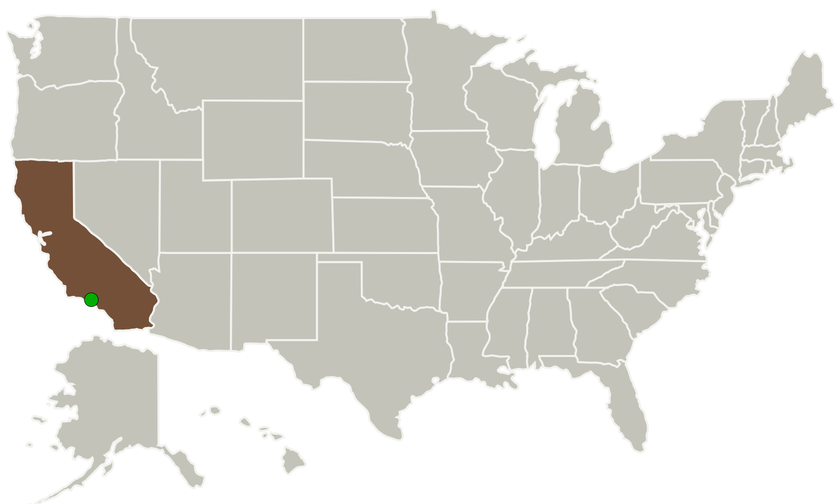
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Stanford University(Stanford)	Lead Organization	Academia	Stanford, California
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations
California

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Stanford University (Stanford)

Responsible Program:

Space Technology Research Grants

Project Management

Program Director:

Claudia M Meyer

Program Manager:

Hung D Nguyen

Principal Investigator:

Mark R Cutkosky

Co-Investigator:

Mikela D Ritter

Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **3**

1 2 3 4 5 6 7 8 9

Applied Research | Development | Demo & Test

Technology Areas

Primary:

- TX04 Robotic Systems
  - └ TX04.5 Autonomous Rendezvous and Docking
    - └ TX04.5.5 Capture Mechanisms and Fixtures

Target Destinations

Earth, Mars